

Late Eocene *Conus* (Neogastropoda: Conidae) from Florida, USA

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ABSTRACT

The neogastropod genus *Conus* is likely the most diverse marine animal genus, but has an Eocene to Pleistocene fossil record that remains poorly understood. We discuss the fossil record of Eocene *Conus* from Florida and recognize three species: *Conus sauridens* Conrad, 1833, and two new species, *Conus palmerae* and *Conus alleni*. We also re-describe *C. sauridens*, identify its likely synonyms, and add new information about its geographic range. The new species *C. palmerae* is restricted to the upper Eocene Ocala Limestone of Florida, while *C. alleni* new species occurs in the upper Eocene Ocala Limestone of Florida and the upper Eocene Moodys Branch Formation of Louisiana.

Additional Keywords: Mollusca, Fossil, Gastropoda, Ocala Limestone

INTRODUCTION

With over 1500 described fossil and extant species, *Conus* Linnaeus, 1758 (cone snails) may be the most diverse marine animal genus (Röckel et al., 1995). Molecular sequence data have offered valuable insights into the relationships of extant *Conus* species (e.g., Duda and Kolm, 2005), but the deep evolutionary history of *Conus* remains unclear: although about 1000 fossil species have been described (Röckel et al., 1995), many of these are likely synonymous (e.g., see Hendricks, in press). Many fossil *Conus* species are based only upon type specimens and/or were described without reference to comparable material from nearby, contemporaneous fossil faunas. Unraveling the early evolutionary history of *Conus* will only be possible by careful examination and interpretation of its rich and well-preserved fossil record.

Some of the oldest substantiated *Conus* fossils are from the early Eocene (Ypresian) of England and France, and possibly Pakistan (Kolm, 1990). Occurrence records of middle Eocene *Conus* in North America show that the genus had achieved a wide geographic distribution soon after its first appearance in the fossil record. For example, Table 1 (which is derived in large part from

Kolm and Anderson, 2008) lists names that have been applied to Eocene *Conus* from the southeastern United States. Our purpose is not to revise the systematics and describe the fossil record of all of these taxa, but rather to focus on those species occurring in Florida, which have thus far received only preliminary attention (Richards and Palmer, 1953). This lack of attention is likely related to the preservational nature of these Floridian specimens, almost all of which are preserved as internal and/or external molds rather than shell material. While we focus on *Conus* fossils from the upper Eocene Ocala Limestone of Florida, we also consider likely synonyms of *Conus sauridens* Conrad, 1833, a widespread and temporally persistent taxon that will require additional future attention.

GEOLOGICAL BACKGROUND

Formally named by W. H. Dall (in Dall and Harris, 1892), the Ocala limestone represented all limestones exposed in central Florida at that time. A late Eocene age was not determined for the Ocala limestone, however, until Cooke (1915) correlated the unit with deposits in Mississippi and Alabama. Based on lithology and microfauna, Applin and Applin (1944) divided the Ocala Limestone into an upper member and lower member. Vernon (1951) redefined the Ocala Limestone by restricting it to Applin and Applin's (1944) upper member and placed their lower member in the Moodys Branch Formation. Further, Vernon (1951) subdivided the Moodys Branch Formation (as pertaining to Florida) into the basal Inglis Member and overlying Williston Member. Puri (1953) renamed Vernon's (1951) Ocala Limestone (restricted) as the Crystal River Formation. Later, Puri (1957) elevated the Ocala Limestone to group status (Ocala Group)—consisting, from oldest to youngest, of the Inglis, Williston, and Crystal River formations—and eliminated the Moodys Branch Formation designation for Florida Eocene deposits. Based on macro- and microfossils, Toulmin (1977: 117) correlated the Inglis Formation with the lower Moodys Branch Formation in

Table 1. Names applied to Eocene *Conus* from the U.S. Coastal Plain, including names of some younger species that are here considered synonyms of Eocene taxa. Type specimen abbreviations: **H**, holotype; **L**, lectotype; and **F**, figured.

Taxon	Type	Type locality	Present disposition according to this study
<i>C. sauridens</i> Conrad, 1833	ANSP 14854 (L)	Claiborne, Alabama	<i>C. sauridens</i>
<i>C. claibornensis</i> I. Lea, 1833	Lost	Claiborne, Alabama	<i>C. sauridens</i> ?
<i>C. gyratus</i> Morton, 1834	ANSP 211 (H)	South Carolina, locality unknown	<i>Nomen dubium</i>
<i>C. parvus</i> H. C. Lea, 1841	ANSP 13161 (L)	Claiborne, Alabama	<i>C. sauridens</i>
<i>C. mutilatus</i> Tuomey, 1852	None	Wilmington, North Carolina	<i>Nomen dubium</i>
<i>C. tortilis</i> Conrad, 1855	ANSP 13196 (H)	Jackson, Mississippi	<i>C. sauridens</i>
<i>C. alveatus</i> Conrad, 1865	ANSP 13446 (L); See MacNeil and Dockery (1984, Pl. 38, Fig. 26)	Vicksburg, Mississippi	<i>C. sauridens</i>
<i>C. subsauridens</i> Conrad, 1865	ANSP 53812 (H)	Probably Claiborne, Alabama	<i>C. sauridens</i>
<i>C. pulcherrimus</i> Heilprin, 1879	AMNH-F1 10175 (H ?)	Claiborne, Alabama	<i>Eosurcula pulcherrimus</i> (a turrid)
<i>C. jacksonensis</i> Meyer, 1885	Unknown, but specimen purported to be holotype figured by Harris and Palmer (1947, pl. 62, fig. 17)	Jackson, Mississippi	<i>C. sauridens</i>
<i>C. deperditus</i> var. <i>subdiadema</i> de Gregorio, 1890	PR1 26436 (H)	Claiborne, Alabama	<i>C. sauridens</i>
<i>C. improvidus</i> de Gregorio, 1890	Lost (see Palmer and Brann, 1966)	Claiborne, Alabama	<i>Nomen dubium</i>
<i>C. (Conospirus) granopsis</i> de Gregorio, 1890	Lost (see Palmer and Brann, 1966)	Claiborne, Alabama	<i>Nomen dubium</i>
<i>C. smithvillensis</i> Harris, 1895	BEG 34656 (H)	Smithville, Texas	<i>C. smithvillensis</i>
<i>C. cornacki</i> Harbison, 1944	ANSP 16415 (H)	Santee Cooper Canal, South Carolina	<i>Nomen dubium</i>
<i>C. (Leptoconus) santander</i> Gardner, 1945	USNM 495181 (H)	Moseleys Ferry, Texas	<i>C. sauridens</i> ?
<i>C. (Leptoconus) highti</i> Gardner, 1945	USNM 495182 (H)	Arroyo Veleno, Texas	<i>C. highti</i>
" <i>Conus</i> sp. A" Palmer in Richards and Palmer, 1953	UF 108683	Gulf Hammock, Florida	Unidentifiable
" <i>Conus</i> sp. B" Palmer in Richards and Palmer, 1953	UF 108558 (designated here as holotype of <i>C. palmerae</i> , new species; formerly FL Geol. Survey I-7634)	Gulf Hammock, Florida	<i>C. palmerae</i> , new species
<i>C. cracens</i> Hoerle, 1976	USNM 220109 (H)	Calhoun County, Florida	<i>C. sauridens</i> ?
<i>C. alveatus spiralis</i> Dockery in MacNeil and Dockery, 1984	USNM 376678 (H)	Smith County, Mississippi	<i>C. sauridens</i>
<i>C. (Lithoconus) smithvillensis</i> var. Dockery, 1980	MGS 590 (F)	Near Newton, Mississippi	<i>C. smithvillensis</i> ?
<i>C. (Lithoconus) nocens</i> Garvie, 1996	UT-TMM 962TX22 (H)	Bastrop County, Texas	<i>C. sauridens</i> ?
<i>C. (Lithoconus) smithvillensis</i> var. Dockery, 1980 in Campbell (1995)	UNC 15448 (F)	Near Cross, South Carolina	<i>C. smithvillensis</i> ?

Alabama, Mississippi, and Louisiana. He also correlated the Williston Formation with the upper Moodys Branch Formation in Alabama, Mississippi, and Louisiana. For detailed correlations, see the Correlation of Stratigraphic Units of North America—Gulf Coast Region (1988).

Based on lithology, Scott (1991)—in order to follow the North American Stratigraphic Code (North American Commission on Stratigraphic Nomenclature, 1983)—reduced the Ocala Group to formational rank and returned to the terminology used by Applin and Applin (1944). Therefore, current designations used by

the Florida Geological Survey and United States Geological Survey are: lower member of the Ocala Limestone (formerly Inglis Formation) and upper member of the Ocala Limestone (formerly Williston and Crystal River formations). See Figure 1 for a brief history of stratigraphic divisions of the Ocala Limestone in Florida.

In outcrop and shallow subsurface, the Ocala Limestone occurs in northwestern peninsular Florida and a small area of the Florida panhandle adjacent to Georgia and Alabama. Lithologically, the Ocala Limestone is a relatively pure carbonate. Non-carbonate minerals

SERIES	STAGE	Applin & Applin 1944		Vernon, 1951	Pun, 1957	Scott, 1991
UPPER EOCENE	JACKSONIAN	Ocala Limestone		Upper Member	Ocala Limestone (restricted)	
		Moody's Branch Formation	Williston Member	Ocala Group	Crystal River Formation	
			Ingilis Member		Williston Formation	
				Ingilis Formation		
		Ocala Limestone		Lower Member	Upper Member	

Figure 1. History of stratigraphic divisions of the Ocala Limestone in Florida (modified from Oyen and Portell, 2001).

(quartz, chert, and clay minerals) represent less than 5% of the rock volume in the lower member and less than 10% in the upper member (Oyen, 1995). The lower member (formerly Inglist Formation) is primarily a clean packstone and grainstone that represents a higher energy, subtidal environment while the upper member (formerly Crystal River Formation) has a lithology of muddy packstone and wackestone interpreted to signify a lower energy (below wave base), deeper subtidal deposit (Fenk, 1979).

The Ocala Limestone contains diverse and abundant, shallow water marine invertebrate fossils consisting primarily of foraminifera, mollusks, and echinoids. Taxa with calcitic shells are preserved as body fossils, while taxa that had aragonitic shells typically occur as internal and external molds, although on rare occasions they can be found as pseudomorphs of calcite or silica. Most of the calcitic shelled mollusks (e.g., oysters and scallops) and those found as pseudomorphs have been well documented (Harris, 1951; Richards and Palmer, 1953). Few of the many moldic Ocala Limestone mollusks, however, have received the critical attention that they need (Portell and Vokes, 1997).

MATERIALS AND METHODS

Most of the specimens examined in this study are from the Florida Museum of Natural History (FLMNH) Division of Invertebrate Paleontology at the University of Florida (UF) and locality details for individual UF specimen lots listed below can be accessed online via the FLMNH Invertebrate Paleontology database at <http://www.flmnf.ufl.edu/invertpaleo/search.asp>. Besides UF specimens, some type specimens from the Academy of Natural Sciences, Philadelphia (ANSP), the Texas Natu-

ral Science Center at the University of Texas (specimens carry the acronym TMM for Texas Memorial Museum), and the Texas Bureau of Economic Geology (BEG; specimens now at the Texas Natural Science Center) were also examined. Other specimens referred to in the text are from the Geological Survey of Alabama (GSA), the American Museum of Natural History (AMNH), the Mississippi Geological Survey (MGS), the Paleontological Research Institution (PRI), the University of North Carolina (UNC), and the United States National Museum of Natural History (USNM).

Morphospecies were recognized from museum specimens (primarily those at the FLMNH) using the criteria discussed by Smith (1930), Röckel et al. (1995), and Hendricks (in press) and morphological terminology and measurements collected follow those authors. Two terms are introduced here that relate to characters states of the subsutural flexure, which is "the backward curving or bending of the shell aperture below the suture of whorl contact" and "[b]eing a feature of the apertural margin it is strikingly manifest in the growth lines [on the sutural ramp] of well-preserved cones" (Smith, 1930: 284). These two terms are: symmetrically curved subsutural flexure and diagonal subsutural flexure. A symmetrically curved subsutural flexure (also see the more generalized "curved type" described by Smith, 1930) has a maximum point of curvature centered between the margins of the sutural ramp. A diagonal subsutural flexure forms a straight or nearly-straight line that crosses diagonally (abaxioventrally) across the sutural ramp. Also see Muñoz-Solís (1999) for illustrations of different subsutural flexure morphologies.

Measurements were collected using digital and dial calipers and include: shell length (SL), maximum diameter (MD), aperture height (AH), height of maximum diameter (HMD), and spire angle (SA). From these measurements, the following morphometric ratios (developed by Röckel et al., 1995) were computed to characterize shell shape: relative diameter (RD; $RD = MD / AH$); position of maximum diameter (PMD; $PMD = HMD / AH$); and relative spire height (RSH; $RSH = [SL - AH] / SL$). Recognized Floridian morphospecies were compared with previously described species of Eocene *Conus* from the southeastern United States.

Although the simple internal molds of *Conus* fossils offer little taxonomically relevant information, room temperature vulcanizing (R.T.V.) silicone rubber casts made from external molds are often very useful for recognizing species. The external molds discussed herein were first gently cleaned to remove loose debris and then impregnated with polyvinyl butyral (Butvar-76), if needed, to consolidate the limestone. Once dried, clay dams were constructed around the outside of the limestone blocks containing the external molds. Then, de-aerated R.T.V. silicone rubber was slowly poured into and above the molds and again de-aerated in a vacuum chamber. Later, the cured rubber casts were carefully lifted from the molds. For more information regarding this technique

see Chaney (1989) or visit <http://paleo.cc/casting/silsum.htm>.

SYSTEMATICS

Our examination of Eocene *Conus* fossils from Florida resulted in the recognition of one distinctive morpho-species that was first described by Conrad (1833) as *C. sauridens*, and two new species (*C. palmerae* and *C. allenii*) which are described below.

Family Conidae Fleming, 1822

Genus *Conus* Linnaeus, 1758

Conus sauridens Conrad, 1833
(Figures 2–10, 15–22; Table 2)

Conus sauridens Conrad, 1833: p. 33; Conrad, 1835: pl. 15, fig. 7. For comprehensive synonymy listings, see Palmer (1937), Harris and Palmer (1947), and Palmer and Brann (1966).

?*Conus clabornensis* I. Lea, 1833: 186.

Conus parvus H. C. Lea, 1841: 103, pl. 1, fig. 24.

Conus tortilis Conrad 1855: 260, pl. 15, fig. 5.

Conus alveatus Conrad, 1865: 148, pl. 11, fig. 4.

Conus subsauridens Conrad, 1865: 148, pl. 11, fig. 9.

Conus jacksonensis Meyer, 1885: 466.

Conus deperditus var. *subdiadema* de Gregorio, 1890: 20, pl. 1, figs. 56–58.

?*Conus* (*Leptocomus*) *santander* Gardner, 1945: 251, pl. 26, figs. 5, 9, 10, 14.

?*Conus cracens* Hoerle, 1976: 14, 16, pl. 3, figs. 1–3.

Conus alveatus spiralis Dockery in MacNeil and Dockery, 1984: 165, pl. 59, figs. 3, 4.

?*Conus nocens* Garvie, 1996: 90, pl. 19, figs. 9, 10.

Diagnosis: Early postnuclear whorls tuberculate, later teleoconch whorls smooth; shell often widest below shoulder; shoulder typically ridge-like; sutural ramps with raised spiral threads; incised spiral grooves at base of shell.

Description: Shell medium to large-sized (up to 116 mm). Last whorl conical to broadly and ventricosely conical; outline typically convex near shoulder, nearly straight below. Shell often widest below shoulder. Shoulder typically broadly carinate and forming pronounced ridge, less often angulate; smooth. Spire of low to moderate height, spire angle (SA) typically obtuse; outline typically straight to concave in smaller specimens, usually sigmoidal in larger shells. Larval shell multispiral, with at least three whorls. Early postnuclear whorls tuberculate. Subsutural flexure symmetrically curved, depth about 2.5× width. Teleoconch sutural ramps typically sigmoidal (rarely flat or convex), with raised spiral threads (typically three to seven; number increases with shell size) and intervening grooves; ornamentation begins on earliest postnuclear whorls as a single incised spiral groove. Aperture opening of approximately uniform width from base to shoulder. Some large specimens bear a pronounced siphonal fasciole. Last whorl with incised spiral grooves at base,

sometimes extending weakly to near center of whorl and occasionally to shoulder in small shells; spiral grooves obsolete in some large shells.

Shell Morphometrics: Thirteen shells of type and non-type specimens of *C. sauridens* were measured and morphometric ratios were computed from these measurements (Table 2): relative diameter (RD) ranges from 0.57–0.74 (average = 0.67); position of maximum diameter (PMD) ranges from 0.83–0.95 (average = 0.91); and relative spire height (RSH) ranges from 0.09–0.21 (average = 0.17).

Type Specimens: Type specimens examined include: ANSP 14854, lectotype of *Conus sauridens* (Figures 2, 3); ANSP 53813, three paralectotypes of *C. sauridens* (Figures 4–6); ANSP 53812, holotype of *C. subsauridens* (Figure 7); ANSP 13161, holotype of *C. parvus* (Figure 8); and ANSP 13196, holotype of *C. tortilis* (Figures 9, 10). See Table 2 for measurements of type specimens.

Type Locality and Occurrence: Conrad (1833) described the species from specimens collected at Claiborne, Alabama. Palmer (1937: 10) designated the type locality and stratum of *Conus sauridens* as PRI station 104: “‘Ferruginous sand’ bed at Claiborne, on the Alabama River, Monroe County, Ala. Gosport sand” (Palmer, 1937: 10). The Gosport Sand is the uppermost formation of the Claiborne Group and is late middle Eocene (Bartonian) in age (Dockery, 1980). This species has been previously reported from numerous Paleogene U.S. Gulf Coast strata, including the middle Eocene Claiborne Group, as *C. tortilis* in the upper Eocene Jackson Group, and as *C. alveatus* in the lower Oligocene Vicksburg Group (the reader is directed to the following sources for detailed discussions of specific occurrence records: Palmer, 1937; Harris and Palmer, 1947; Palmer and Brann, 1966; and MacNeil and Dockery, 1984). *Conus sauridens* also occurs in the upper Eocene Ocala Limestone of Alachua, Suwannee, and Jackson counties, Florida. This species also questionably occurs as *C. cracens* in the lower Miocene Chipola Formation of northern Florida.

Other Material Examined: In addition to the type specimen lots listed above, 28 specimen lots containing *C. sauridens* were examined (over 80 specimens). These include: UF 283, UF 290, UF 2292, UF 8647, UF 14706, UF 16726, UF 16661, UF 18874, UF 57713, UF 57733, UF 100693, UF 101995, UF 114376, UF 115875, UF 119912, UF 119913, UF 119918, UF 119962, UF 120021–UF 120027, UF 120032, UF 122384, and UF 126927.

Discussion: *Conus sauridens* was the third fossil *Conus* species to be described from North America, and the first from the Paleogene (Green described the Neogene species *C. delurianus* and *C. marylandicus* in 1830; see Kolm, 1992). As such, this species has received much attention in the literature, particularly with regards to its



Figures 2–18. Specimens of *Conus sauridens* Conrad, 1833 (2–10, 15–18), *C. cracens* Hoerle, 1976 (11, 12), and *C. nocens* Garvie, 1996 (13, 14). See text and Table 1 for locality information. All scale bars equal 1 cm. Scale bar above Figure 5 pertains to Figures 2–7 and 11–14. Scale bar below Figure 8 pertains only to that figure. Scale bar between Figures 9 and 10 pertains to Figures 9–10 and 15–18. 2–3. Lectotype (ANSP 14854) of *C. sauridens*, shell length 33.4 mm, maximum diameter 21.1 mm. 4. Paralectotype (ANSP 53513-3) of *C. sauridens*, shell length 31.9 mm. 5. Paralectotype (ANSP 53513-1) of *C. sauridens*, maximum diameter 22.3 mm. 6. Paralectotype (ANSP 53513-2) of *C. sauridens*, shell length 30.2 mm. 7. Holotype (ANSP 53512) of *C. subsauridens* Conrad, 1865, shell length 33.4 mm. 8. Holotype (ANSP 13161) of *C. parvus* Lea, 1841, shell length 6 mm. 9–10. Holotype (ANSP 13196) of *C. tortilis* Conrad, 1855, shell length 90.0 mm, maximum diameter 53.0 mm. 11–12. Paratype (UF 119560-1) of *C. cracens* Hoerle, 1976, shell length 32.2 mm, maximum diameter 17.8 mm. 13–14. Holotype (TMM-962TX22) of *C. nocens* Garvie, 1996, shell length 19.2 mm, maximum diameter 8.7 mm. 15. R.T.V. silicone rubber cast from external mold of *C. sauridens* (UF 120026). 16. R.T.V. silicone rubber cast from external mold of *C. sauridens* (UF 122384). 17–18. Highly leached, heavily pitted, and slightly silicified shell of *C. sauridens* (UF 120027), shell length 27.4 mm, maximum diameter 16.5 mm.

Table 2. Measurements (in mm) and morphometric ratios of type and non-type specimens examined. Some measurements could not be collected from casts made from molds; other measurements (and associated ratios) are not accurate because of shell damage (indicated by an asterisk, °). Morphological abbreviations: **SL**, shell length; **MD**, maximum diameter; **AH**, aperture height; **HMD**, height of maximum diameter; **SA**, spire angle (in degrees); **RD**, relative diameter; **PMD**, position of maximum diameter; and **RSIH**, relative spire height. Specimen abbreviations: **H**, holotype; **L**, lectotype; **P**, paratype; and **PL**, paralectotype.

Specimen	SL	MD	AH	HMD	SA	RD	PMD	RSIH
Type Specimens of <i>Conus sauridens</i> Conrad, 1833								
ANSP 14854 (L , <i>C. sauridens</i> , Figures 2, 3)	33.4	21.1	30.3	28.9	143	0.70	0.95	0.09
ANSP 53813-1 (PL , <i>C. sauridens</i> , Figure 5)	43.6	22.3°	36.5	33.6	106	0.61°	0.92	0.16
ANSP 53813-2 (PL , <i>C. sauridens</i> , Figure 6)	30.2°	15.0	26.2	24.5	110	0.57	0.94	0.13°
ANSP 53813-3 (PL , <i>C. sauridens</i> , Figure 4)	31.9°	16.7	25.9	23.5	101	0.64	0.91	0.19°
ANSP 53812 (H , <i>C. subsauridens</i> , Figure 7)	33.4°	17.3	28.2	26.2	115	0.61	0.93	0.16°
ANSP 13161 (H , <i>C. parvus</i> , Figure 8)	~6	—	—	—	—	—	—	—
ANSP 13196 (H , <i>C. tortilis</i> , Figures 9, 10)	90.9	53.0	75.1	62.1	100°	0.71	0.83	0.17
Non-Type Specimens of <i>Conus sauridens</i> Conrad, 1833								
UF 253	37.59	22.4	30.3	27.7	110	0.74	0.91	0.19
UF 290-1	24.43	11.87	19.3	17.3	90	0.62	0.90	0.21
UF 8511-1	48.83	27.38	40.5	35.6	109	0.68	0.88	0.17
UF 8647	41.44	24.31	33.1	30.6	109	0.73	0.92	0.20
UF 16726	22.95	12.36	19.5	18.0	110	0.63	0.92	0.15
UF 115875	33.45	19.86	28.4	25.7	119	0.70	0.90	0.15
UF 120022	116.11	69.15	95.2	54°	121	0.73	0.88°	0.18
<i>Conus palmerae</i> new species								
UF 108858 (H , <i>C. palmerae</i> , new species, Figures 23, 24)	22.0°	11.5°	14.6°	13.7°	77	—	—	—
UF 15886 (P)	—	22.3°	—	—	103	—	—	—
UF 18599 (P , Figure 25)	50.1°	—	—	—	—	—	—	—
UF 18711 (P)	12.0°	—	—	—	—	—	—	—
UF 18719 (P)	24.9°	—	—	—	—	—	—	—
UF 18737 (P , Figure 26)	56.1°	—	—	—	—	—	—	—
UF 57018 (P)	50.3°	21.5°	—	—	—	—	—	—
UF 66738 (P , Figure 27)	—	14.2°	—	—	101	—	—	—
UF 65306 (P , Figure 28)	—	19.3	—	—	98	—	—	—
UF 74473 (P , Figures 29, 30)	—	19.0°	—	—	98	—	—	—
UF 110360 (P)	65.0°	28.4°	53.8°	—	—	—	—	—
UF 111327 (P)	—	11.3	—	—	108	—	—	—
UF 112981 (P)	—	12.4	—	—	108	—	—	—
<i>Conus allenii</i> new species								
UF 119920 (H , Figures 31, 32)	36.2	20.7°	31.3	28.6	121	0.66°	0.91	0.14
UF 119919 (P , Figure 34)	33.2°	17.3°	—	—	92	—	—	—
UF 119976 (P , Figure 35)	34.5°	17.2°	—	—	—	—	—	—
UF 119977 (P , Figure 33)	35.1°	16.8°	—	—	112°	—	—	—
Other Type Specimens								
ANSP 16145 (H , <i>C. cornacki</i> , Figure 39)	28.7	22.3	—	—	—	—	—	—
UF 119560-1 (P , <i>C. cracens</i> , Figures 11, 12)	32.2	17.8	27.5	24.0	113	0.65	0.87	0.15
UF 76798-1 (P , <i>C. cracens</i>)	68.0	37.3°	—	—	—	—	—	—
TMM-BEG 35656 (H , <i>C. smithwillensis</i> , Figures 36-38)	42.1	14.8°	28.6	26.9°	53	0.52°	0.94°	0.32
TMM-962TX22 (H , <i>C. nocens</i> , Figures 13, 14)	19.2	8.7°	15.1	14.3	87	0.58°	0.95	0.21
TMM-962TX23 (P , <i>C. nocens</i>)	19.4	8.7°	15.4	14.5	87	0.56	0.94	0.21

morphological variation and probable synonyms. Much of the following was derived from discussions in Palmer (1937), Harris and Palmer (1947), and Palmer and Bram (1966).

Timothy Conrad (1833) described *C. sauridens* from shells that he collected at Claiborne, Alabama. According to Palmer (1937: 461), the "Conradian collection of *sauridens* consists of 5 specimens" which were apparently glued to one card, cataloged as ANSP 14854. Palmer (1937: 461) goes on to state that the "type of

Conus subsauridens Con. [see below] is also on the card with the *Conus sauridens* collection." These two passages suggest that Conrad's Claiborne collection originally consisted of six specimens. The collection now consists of five specimens: the lectotype (ANSP 14854; Figures 2, 3) of *C. sauridens*, three paralectotypes (ANSP 53813; Figures 4-6), and the holotype of *C. subsauridens* (ANSP 53812; Figure 7); the location of any possible sixth specimen is not known. One low-spined specimen in the type series (ANSP 14854; Figure 2) closely resembles Con-

rad's (1835, pl. 15, fig. 7) original figure of *C. sauridens*. Palmer (1937) alluded to this specimen in her text as matching Conrad's figure, but did not formally designate it as the lectotype. Kohn (1992)—following Moore (1962) and Palmer and Brann (1966)—considered this specimen to be the lectotype and we accept his conclusion.

Palmer (1937) argued that the matrix filling the apertures of the shells in Conrad's *Conus sauridens* series suggests that the shells do not likely share the same geological provenance. The matrix filling the lectotype is orange and appears to be sand from the Gosport Formation (Palmer, 1937). The matrix filling the three paralectotypes is light-gray. The matrix filling the holotype of *C. subsauridens* is orange, resembling that of the lectotype of *C. sauridens* (Palmer [1937: 461] described the matrix filling the holotype of *C. subsauridens* as "a red, silicified matrix resembling that of the Orangeburg" material from South Carolina). It is important to note, however, that these differences in matrix color may be due to diagenetic weathering of the original matrix material.

The lectotype (ANSP 14854; Figures 2, 3) of *C. sauridens* differs from the paralectotypes (ANSP 53813; Figures 4–6)—which, with the holotype of *C. subsauridens* (see below), are of the much more common morphology—in the following respects: it has flat to slightly convex sutural ramps with more raised spiral threads (about 6) than is typical, the shoulder is angulate rather than forming a carinate ridge, the widest point of the last whorl is nearly at the shoulder rather than beneath it, and the spire is lower than in most other specimens of the species (see Table 2); further, the lectotype does not provide definite evidence of tubercles on the early post-nuclear whorls, though these are highly eroded on this specimen.

Isaac Lea (1833) described *Conus claibornensis* from materials sent to him by Judge Charles Tait of Claiborne, Alabama, but lost his only specimen before it could be figured (Kohn, 1992). His description suggests that his specimen was a *C. sauridens*, a name that has priority by three months (Kohn, 1992). Harris (1895), Palmer (1937), and Palmer and Brann (1966) synonymized *C. claibornensis* with *C. sauridens*, while de Gregorio (1890), Dall (1896), and Kohn (1992) regarded this taxon as a *nomen dubium*. Given that no available evidence suggests that more than one fossil *Conus* species is present at Claiborne, Alabama, we agree with the former authors that *C. claibornensis* is equivalent, while questionably, to *C. sauridens*. For a historical overview of interactions between I. Lea, T. A. Conrad, and C. Tait, see Wheeler (1935).

In 1841, H. C. Lea (I. Lea's father) described *Conus parvus* on the basis of a single, small, damaged shell (ANSP 13161; Figure 5) from the Gosport sand at Claiborne, Alabama. We agree with Dall (1896), Palmer (1937), and Palmer and Brann (1966) that *C. parvus* is a juvenile *C. sauridens*. Features uniting the holotype of *C.*

parvus with *C. sauridens* include: tuberculate early post-nuclear whorls, raised spiral threads on the sutural ramps, and incised spiral grooves on the anterior half of the last whorl.

Conrad (1855) described *Conus tortilis* from one large specimen (ANSP 13196; Figures 9, 10) from Jackson, Mississippi and differentiated it from *C. sauridens* by its "more prominent and convex spire, in the large twisted callus at base, & c." (p. 260). Dall (1896) and Palmer (1937) both considered *C. tortilis* synonymous with *C. sauridens* and Palmer (1937) described *C. tortilis* as representing "the maximum growth of the species" (p. 459). We agree with these authors that specimens of *C. tortilis* are large *C. sauridens*.

Conrad (1865) described two additional species of Eocene *Conus*: *C. subsauridens* and *C. alveatus*. Conrad stated that *C. subsauridens* was from "the Burrstone, probably, of Alabama"; we assume (see above) that the holotype (ANSP 53812) is from Clairborne. We inspected the type of *C. subsauridens* (Figure 7) and agree with Dall (1896) and Palmer (1937) that it is a junior synonym of *C. sauridens*.

The type locality for *Conus alveatus* is Vicksburg, Mississippi; MacNeil and Dockery (1984) suggested that the lectotype (ANSP 13446; MacNeil and Dockery, 1984, pl. 38, fig. 26) and paratype (ANSP 13494) are probably from the Byram Formation. Conrad (1865: 145) differentiated *C. alveatus* from *C. sauridens* by its "less elevated and . . . more profoundly carinated spire, and the revolving lines on the spire are less numerous than in the former [*C. sauridens*]." Dall (1896) and Palmer (1937) recognized *Conus tortilis* and *C. alveatus*, respectively, as the Jacksonian (upper Eocene) and Vicksburgian (lower Oligocene) forms of the older, Clairbornian (middle Eocene), *C. sauridens*. MacNeil and Dockery (1984), however, continued to recognize *C. alveatus* as a distinct Oligocene species occurring in Mississippi and Mexico; they did not compare *C. alveatus* (or Dockery's subspecies *C. alveatus spiralis*; in MacNeil and Dockery, 1984) with *C. sauridens*. MacNeil and Dockery's (1984) figures of *C. alveatus* (including the lectotype; pl. 38, fig. 26) appear consistent with *C. sauridens* as circumscribed here.

Meyer (1885) described—but did not figure—*Conus jacksonensis* from Jackson, Mississippi, and described the species as similar to *Conus protracta* Meyer, 1885 (an Oligocene taxon from Vicksburg and Red Bluff, Mississippi that we accept, but do not consider further here; see MacNeil and Dockery, 1984 for details), but "with revolving lines on the spire" (p. 466). Meyer [1886] presented *C. protracta* as *C. protractus* and the latter spelling is the one most commonly seen in the literature. Harris and Palmer (1947: pl. 62, fig. 17) figured a specimen (unnumbered, but said to be from the collections of the Geology Department of Johns Hopkins University) that they regarded as the holotype of *C. jacksonensis*. This specimen "consists of the apical whorls" and is 3.5 mm in size (Harris and Palmer, 1947: 446). Harris and

Palmer (1947) considered this taxon a junior synonym of *C. sauridens* and we agree, particularly because of the presence of tuberculate early postnuclear whorls and the presence of raised spiral threads on the sutural ramp.

De Gregorio (1890) described *Conus deperditus* var. *subdiadema* from Claiborne, Alabama. Palmer and Brann (1966) considered this subspecies equivalent to *C. sauridens* and, based upon our inspection of de Gregorio's (1890) figures, we agree. We have not, however, viewed the holotype of *C. deperditus* var. *subdiadema*, which Palmer and Brann reported as PRI 26436.

Gardner (1945: 252) described *Conus santander* as including "those species from the western Gulf that have formerly been included under *Conus sauridens* Conrad, described from Claiborne." Gardner's figures of the holotype (USNM 495181; Moseleys Ferry, Burleson County, Texas) of *C. santander* appear consistent with *C. sauridens* and we consider this taxon a probable synonym.

Hoerle (1976) described *Conus craccus* (see paratype in UF 119560, Figures 11, 12) from the lower Miocene Chipola Formation of northern Florida and noted its strong similarity to *C. sauridens*: "*C. craccus* appears to be a descendant of the widespread (Alabama, Mississippi, Texas) middle Eocene to Oligocene species, *C. sauridens* Conrad" (p. 16). She differentiated *C. craccus* from *C. sauridens* on the basis of several characters: the "nodes on the spire whorls persist for a greater number of turns on *C. craccus*, also it is larger, more slender, with stronger and more opisthocyrte growth lines and more pronounced basal ornament" (p. 16). We examined Hoerle's paratypes at the FLMNH and could not find any discrete morphological characters separating the two taxa. Given the vast amount of geological time separating the species (over 12 million years), however, we questionably synonymize *C. craccus* with *C. sauridens*. Resolving the relationship between these two taxa will require additional study.

Finally, Garvie (1996) described *Conus nocens* on the basis of two small specimens from the Reklaw Formation of Bastrop County, Texas: TMM-962TX22 (holotype; erroneously published as UT-TMM 84822; Figures 13, 14) and TMM-962TX23 (paratype, erroneously published as UT-TMM 84823). In addition to these two specimens, Garvie (1996) reported that he examined 25 additional specimens of *C. nocens* from the Weches Formation and over 100 specimens from the Cook Mountain Formation. While we did not observe these additional, stratigraphically younger specimens, the holotype and paratype of *C. nocens* appear consistent with *Conus sauridens*. They each have raised spiral threads on the sutural ramp, symmetrically curved subsutural flexures, and incised spiral grooves on the anterior half of the last whorl. Further, both have last whorl shapes similar to *C. sauridens*. The early postnuclear whorls of the holotype are tuberculate, but most appear smooth on the paratype. Garvie (1996: 90) stated that four characters separate *C. nocens* from *C. sauridens*: "the flat sides, the sharp unridged carina,

the coarse, strong, spiral basal lines, and the lack of strong growth lines on the ramp." We do not consider these characteristics—in isolation or combination—sufficient to discriminate *C. nocens* from *C. sauridens* (as circumscribed above), especially because TMM-962TX22 and TMM-962TX23 are both shells of juveniles. Since, however, we have not seen the other specimens of *C. nocens* mentioned by Garvie (1996), we consider our synonymy of *C. nocens* with *C. sauridens* tentative. Regardless of their taxonomic identity, TMM-962TX22 and TMM-962TX23 are important specimens because of their likely stratigraphic position in the Reklaw Formation. The Reklaw Formation is thought to span the early-middle Eocene (or, Ypresian-Lutetian) boundary and has a relative age equivalent to nannoplankton biochronozones NP14 (Zachos and Molineux, 2003: fig. 2), which has an absolute age of about 49.7 to 47.3 Ma (Berggren and Pearson, 2005). This age would make these two specimens the oldest known *Conus* fossils from the United States Coastal Plain, and only slightly younger than the oldest *Conus* in general (Ypresian of England and France; Kohn, 1990). This oldest regional occurrence record is tempered, however, by the fact that the position of the original collection locality of TMM-962TX22 and TMM-962TX23 ("Devil's Eye, Colorado R."; station 11 of the Geological Survey of Texas and locality 11-T-36 of the Texas Bureau of Economic Geology) is uncertain (Zachos et al., 2005) and may no longer exist (Garvie, 1996). Further, no additional specimens of *Conus* from the Reklaw Formation have yet been found in the collections of the Texas Natural Science Center (A. Molineux, personal communication to JRI1, July 11, 2007).

Most of our knowledge of Eocene *C. sauridens* in Florida is from R.T.V. silicone rubber casts of external molds in limestone (e.g., UF 120026, Figure 15; UF 122384, Figure 16), though UF 120027 (Figures 17, 18)—which is a highly leached, heavily pitted, and slightly silicified shell—is an exception. *Conus sauridens* is present in upper Eocene Ocala Limestone of Jackson (UF 18874, UF locality JA002; UF 120026, UF locality JA018; UF 119912, UF locality JA027; and UF 119918, UF locality JA031), Alachua (UF 120027, UF locality AL001), and Suwannee (UF 122384 and UF 120032, both UF locality SU003) counties. Finally, one additional specimen (UF 119913) that may be *C. sauridens* is from the lower Oligocene Bumpnose Limestone of Jackson County (UF locality JA025). Besides these records, the only other known record of this taxon (as recognized here) in Florida is Dall's (1916: 4489) account of *C. tortilis* in the "Ocala." *Conus sauridens* co-occurs in the Eocene of Florida with the new species *C. palmerae* and *C. allenii*; characteristics that distinguish the new species from *C. sauridens* are discussed below.

A complete review of the fossil record of *Conus sauridens* is beyond the scope of this paper, though the preliminary observations we have made here support earlier demonstrations (Palmer, 1937) that *C. sauridens*

was a morphologically variable, geographically widespread, and temporally persistent species. While the oldest known (early Eocene) *Conus* fossils were small (<35 mm in shell length), larger species (ca. 70 mm in shell length) have previously been reported from the middle Eocene (Kohn, 1990). During this study, we recognized a very large (shell length, 116.1 mm) specimen (UF 120022; Figure 19) of *C. sauridens* from the upper Eocene Moodys Branch Formation of Grant Parish, Louisiana (UF locality ZL004). This specimen may be the largest *Conus* yet known from the Eocene of the U.S. Coastal Plain. The large geographic range of *C. sauridens* could be related to its developmental mode, which was likely planktotrophic based upon its multispiral larval shell (Figures 20–22), though testing this hypothesis within the context of Shuto's (1974) model of the relationship between developmental mode and larval shell morphology (also see Kohn and Perron, 1994) will require additional study. While not necessarily useful as a guide fossil, shells of *C. sauridens* (as circumscribed here) have recently been utilized in several isotopic studies (Kobashi et al., 2001; Kobashi and Grossman, 2003; Kobashi et al., 2004) of Paleogene climate and have proven to be geologically useful in this regard.

Conus palmerae new species
(Figures 23–30, Table 2)

Conus sp. B. Palmer in Richards and Palmer, 1953: 40, pl. 2, fig. 14.

Diagnosis: Teleoconch whorls stepped; early post-nuclear whorls smooth; sutural ramps typically smooth; last whorl smooth.

Description: Shell small to moderately large-sized (up to about 65 mm in length). Last whorl conical; outline slightly concave. Shoulder sharply angulate, smooth. Spire of moderate height; outline concave to straight. Teleoconch whorls stepped; spire angle of early whorls typically obtuse relative to later whorls. Larval shell unknown. Early postnuclear whorls smooth. Subsutural flexure symmetrically curved. Teleoconch sutural ramps concave and typically smooth, though occasionally 2 or 3 weak spiral threads are present. Aperture morphology unknown. Last whorl typically smooth, though fine spiral lines may cover the last whorl of some small specimens.

Type Specimens: Holotype UF 108538 (Figures 23, 24), a specimen originally described as "*Conus* sp. B" by Palmer in Richards and Palmer (1953: 40, pl. 2, fig. 14). The holotype is preserved as a calcite-replaced shell. All paratypes are moldic (consisting of just external or external and internal molds) and include: UF 15586, UF 15599 (Figure 25), UF 15711, UF 15719, UF 15737 (Figure 26), UF 57015, UF 66738 (Figure 27), UF 68306 (Figure 28), UF 74473 (Figures 29, 30), UF 110360, UF 111327, and UF 112951. See Table 2 for measurements of these specimens.



Figures 19–22. Specimens of *Conus sauridens* Conrad, 1833. **19.** Largest known specimen (UF 120022) of *C. sauridens*, shell length 116.1 mm, Moodys Branch Formation, UF locality ZL004 (Montgomery Landing 01), Grant Parish, Louisiana; scale bar equals 1 cm. **20.** Juvenile shell (UF 126927), shell length 3.4 mm, Moodys Branch Formation, UF locality ZL004 (Montgomery Landing 01), Grant Parish, Louisiana; scale bar equals 1 mm. **21–22.** Shell (GSA 2007.005), shell length 60.5 mm, Moodys Branch Formation, Montgomery Landing, Grant Parish, Louisiana; Figure 21 shows the larval shell and early postnuclear whorls of this specimen, which is also shown in Figure 22 (both scale bars equal 1 cm).



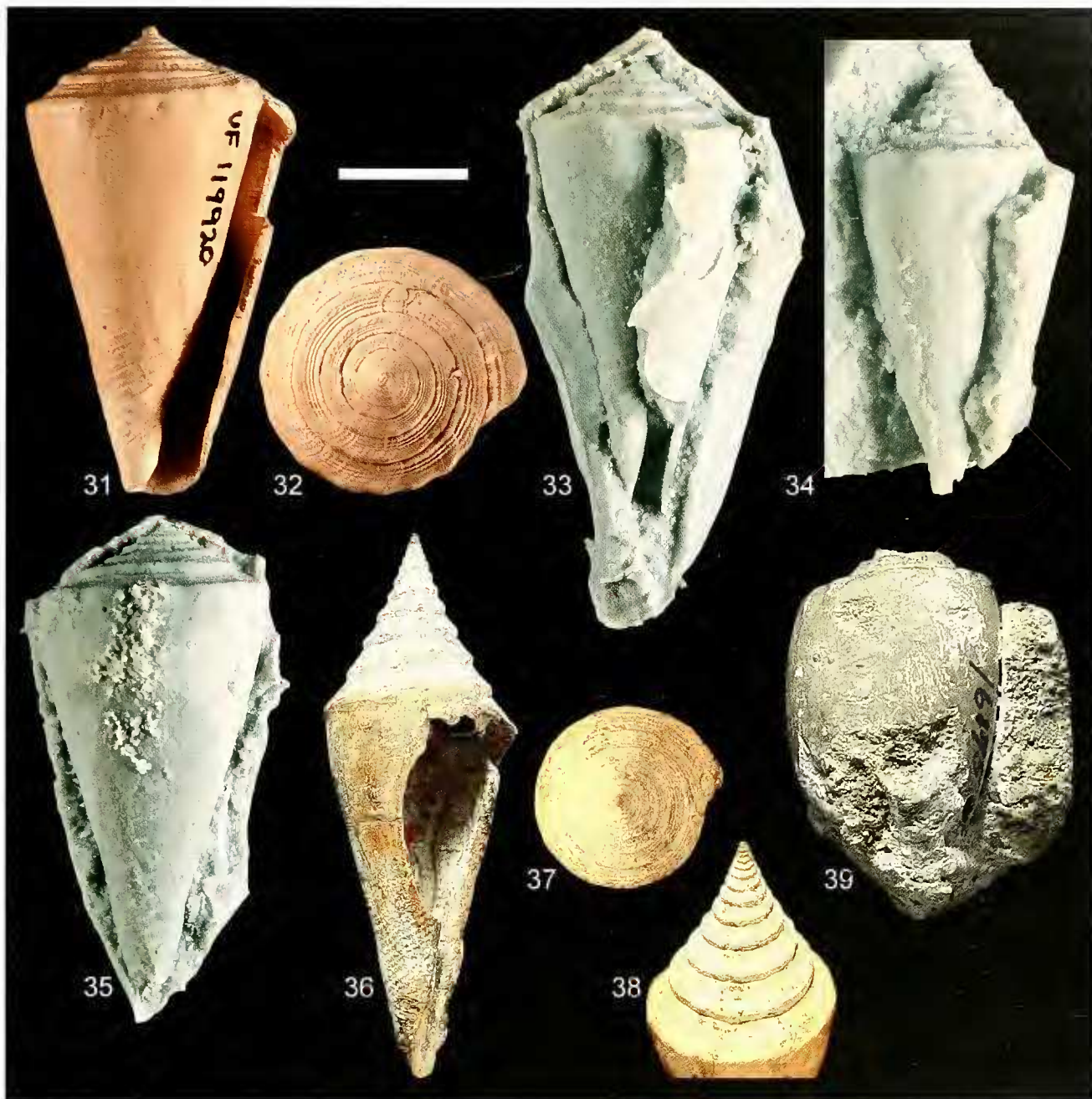
Figures 23–30. Specimens of *Conus palmerae* new species. All scale bars equal 1 cm. **23–24.** Holotype (UF 108858), preserved shell length 22.0 mm, preserved maximum diameter 11.5 mm, lower member of the Ocala Limestone (formerly Inglis Formation), UF locality LV014 (Gulf Hammock 02), Levy County, Florida. **25.** R.T.V. silicone rubber cast of paratype (UF 18599), preserved shell length 50.1 mm, preserved maximum diameter 23.4 mm, Ocala Limestone, UF locality AL016 (S.M. Wall Quarry 01), Alachua County, Florida. **26.** R.T.V. silicone rubber cast of paratype (UF 18737), preserved shell length 56.1 mm, preserved maximum diameter 24.1 mm, Ocala Limestone, UF locality LF001 (Dell Limerock Mine), Lafayette County, Florida. **27.** R.T.V. silicone rubber cast of paratype, (UF 66738), maximum diameter 14.2 mm, Ocala Limestone, UF locality AL028 (Newberry 03), Alachua County, Florida. **28.** R.T.V. silicone rubber cast of paratype (UF 68306), maximum diameter 19.3 mm, Ocala Limestone, UF locality AL004 (Dickerson Limerock Mines), Alachua County, Florida. **29–30.** R.T.V. silicone rubber cast of paratype (UF 74473), preserved maximum diameter 19.0 mm, Ocala Limestone, UF locality AL004 (Dickerson Limerock Mines), Alachua County, Florida; the topmost portion (indicated by arrow) of Figure 29 is magnified 3.5× in relation to Figure 30 to show details of the sutural ramps.

Type Locality and Occurrence: The holotype (UF 108858; Figures 23, 24) is from the lower member of the Ocala Limestone (formerly the Inglis Formation) at UF locality LV014, Gulf Hammock 02, Levy County, Florida. Richards and Palmer (1953: 5) described the locality (R. O. Vernon's L-93) as a "road metal pit 2.9 miles south of the north limits of the town of Gulf Hammock just southwest of State Road 55 in the southwest quarter of Section 34, Township 14 South, Range 16 East." The paratype specimens are from Alachua County (UF 68306, UF 74473, UF 111327, and UF 112981, UF locality AL004, Dickerson Limerock Mines, Ocala Limestone; UF 18599, UF locality AL016, S.M. Wall Quarry 01, Ocala Limestone; UF 15886, UF locality AL017, Newberry Corporation Pit 01, Ocala Limestone; and UF 66738, UF locality AL028, Newberry 03, Ocala Limestone) and Lafayette County (UF 18711, UF 18719, UF

18737, UF 57018, and UF 110360, UF locality LF001, Dell Limerock Mine, Ocala Limestone). Thus, all specimens of *C. palmerae* are from the upper Eocene, Jacksonian Ocala Limestone of Florida.

Etymology: This species is named in honor of Katherine V. W. Palmer (1895–1982), second director of the Paleontological Research Institution (Ithaca, NY), who was the first to recognize this form as a new, undescribed species and for her important contributions to Cenozoic paleontology (see Caster, 1983).

Discussion: Palmer (1953) did not describe UF 108858 as a new taxon because she did not consider this single damaged shell adequate for this purpose. Newly collected specimens (all molds) are consistent with the gross morphology of Palmer's fossil, but offer new mor-



Figures 31–39. Specimens of *Conus alleni* new species (31–35), *C. smithvillensis* Harris, 1895 (36–38), and *C. cormacki* Harbison, 1944 (39). Scale bar equals 1 cm. **31–32.** Holotype (UF 119920) of *C. alleni*, shell length 36.2 mm, preserved maximum diameter 20.7 mm, Moodys Branch Formation, UF locality ZL004 (Montgomery Landing), Grant Parish, Louisiana. **33.** Paratype (UF 119977) of *C. alleni*, preserved shell length 35.1 mm, Ocala Limestone, UF locality LF002 (Mill Creek Quarry), Lafayette County, Florida. **34.** Paratype (UF 119919) of *C. alleni*, preserved shell length 33.2 mm, Ocala Limestone, UF locality SU014 (Suwannee American Cement), Suwannee County, Florida. **35.** Paratype (UF 119976) of *C. alleni*, preserved shell length 34.5 mm, UF locality LF002 (Mill Creek Quarry), Lafayette County, Florida. **36–38.** Holotype (TMM-BEG 35656) of *C. smithvillensis*, shell length 42.1 mm, preserved maximum diameter 14.8 mm, Weches Formation, Colorado River at Smithville, Bastrop County, Texas. **39.** Holotype (ANSP 16145) of *C. cormacki* (not a *Conus*; see text), preserved shell length 28.7 mm, Santee Cooper Canal, South Carolina.

phological details that now justify description of this species.

Conus palmerae co-occurs in the Ocala Limestone with two other late Eocene *Conus* in Florida: *C. sau-*

ridens Conrad, 1833, and *C. alleni* new species. *Conus palmerae* may be distinguished from both of these species by its stepped teleoconch whorls, smooth early postnuclear whorls, smooth sutural ramps, and smooth last whorl.

Conus allenii new species
(Figures 31–35, Table 2)

Diagnosis: Shoulder undulate; subsutural flexure diagonal; last whorl with raised spiral cords on anterior half.

Description: Shell medium-sized (up to about 36 mm in length). Last whorl conical; outline straight to slightly sigmoidal (convex near shoulder). Shell widest at shoulder. Shoulder angulate and with large tubercles resulting from weak undulations. Spire of moderate height; outline straight to slightly concave. Larval shell unknown. Early postnuclear whorls tuberculate. Subsutural flexure diagonal, depth about 1.5× width. Teleoconch sutural ramps concave with several raised spiral cords. Aperture opening about as wide at base as at shoulder. Last whorl with pronounced raised spiral cords on anterior half, sometimes extending weakly as threads to shoulder.

Type Series: Holotype, UF 119920 (Figures 31, 32). The three paratypes consist of external molds and include UF 119977 (Figure 33), UF 119919 (Figure 34), and UF 119976 (Figure 35). See Table 2 for measurements of these specimens.

Type Locality and Occurrence: The holotype (UF 119920, Figures 31, 32) was collected by J. E. Allen from the Jacksonian Moodys Branch Formation at Montgomery Landing (UF locality ZL004), Grant Parish, Louisiana. The paratypes are all from the Ocala Limestone of Florida, including two specimens from Lafayette County (UF 119976, UF 119977, UF locality LF002, Mill Creek Quarry) and one specimen from Suwannee County (UF 119919, UF locality SU014, Suwannee American Cement).

Etymology: This species is named in honor of James E. Allen (1914–1997) of Alexandria, Louisiana, who was an enthusiastic collector and scholar of Gulf Coast Eocene mollusks.

Discussion: *Conus allenii* co-occurs in the Eocene of Louisiana with *C. sauridens* and in the Ocala Limestone of Florida with *C. palmerae* new species and *C. sauridens*. *Conus allenii* can be readily differentiated from both species by its undulate shoulder and spiral cords on the anterior half of the last whorl (raised spiral threads on the last whorl may also be present on small shells of *C. palmerae*, but if so are much weaker).

Conus allenii shares some resemblance with a moldic Oligocene fossil (USNM 166720) from Decatur County, Georgia that Dall (1916) described as *C. vaughani*. Dall's (1916: pl. 86, fig. 1) figure of the cast shows a specimen (partially obscured by matrix) with an obtuse spire angle, undulate shoulder, and raised spiral threads on the sutural ramps that are similar to the teleoconch morphology of *C. allenii*. The presence of rows of spiral beads on the last whorl, the fact that the shell is widest below the shoulder (rather than at the shoulder, as in *C. allenii*), and the fact that the anterior end of the shell appears com-

pletely obscured by matrix prevents us, however, from considering these two forms equivalent.

The only known shell material of *Conus allenii* is the holotype (from Grant Parish, Louisiana); the other three specimens are from Florida and all consist of external molds. This taxon was apparently rare, especially outside of Florida. We recognized this new form from the moldic Floridian material before we—by chance—discovered the similar shell from Louisiana in the FLMNH collections. We chose to designate the shell as the holotype, rather than one of the paratype external molds, because of its greater number of characters available for observation.

OTHER RECORDS OF EOCENE CONUS FROM THE U.S. COASTAL PLAIN

Unidentifiable internal molds of *Conus* are common in the Eocene Ocala Limestone of northern Florida. We examined 54 such lots (over 440 specimens) from Alachua, Citrus, Jackson, Lafayette, Marion, and Suwannee counties. These include: UF 15884, UF 15892, UF 15905, UF 17831, UF 17832, UF 17879, UF 17947, UF 17950, UF 17967, UF 18423, UF 18759, UF 18848, UF 18864, UF 18896, UF 18955, UF 18962, UF 19140, UF 19174, UF 19204, UF 19215, UF 20744–20746, UF 46435, UF 68270, UF 107265, UF 119900–UF 119904, UF 119906–119911, UF 119914–119917, UF 119921, UF 120027, UF 120032–120040, UF 120047, and UF 126926.

During the course of this work, we became aware of several other Eocene Coastal Plain *Conus* species that are likely distinct, but are not known to occur in Florida and will require additional investigation; these include: *Conus smithvillensis* Harris, 1895; *C. smithvillensis* var. Dockery, 1980 (also see *C. smithvillensis* var. Dockery in Campbell, 1995); and *Conus highti* Gardner, 1945.

Harris (1895) described *C. smithvillensis* from the Colorado River at Smithville, Bastrop County, Texas (Weches Formation according to TMM records). The holotype (TMM-BEG 35656; Figures 36–38) shares some characteristics with *C. sauridens* (including a multispiral protoconch, tuberculate early postnuclear whorls, spiral threads on the sutural ramp, growth lines showing a deep and symmetrically curved subsutural flexure, and incised spiral grooves near the base of the last whorl), but has a very different overall shell shape: the spire is much higher (spire angle: 53°, Table 2; in mature individuals of *C. sauridens*, the spire angle is typically over 100°), the conical last whorl has straight sides, and the sutural ramps are flat. Dockery (1980) figured a shell (MGS 590) from the slightly younger Cook Mountain Formation of Mississippi that he described as a variety of *C. smithvillensis*. His figured shell appears to bear many of the discrete characteristics of *C. smithvillensis* described above, though has a lower spire (ca. 76°) and the last whorl is sigmoidal in profile. *Conus smithvillensis* is not at all similar in form to *C. palmerae*. While it bears some of the shell characteristics of *C. allenii*, it lacks *C. allenii*'s

distinctive raised spiral cords at the base of the last whorl. Campbell (1995) attributed an external mold (UNC 15448) from the Santee Limestone near Cross, South Carolina to Dockery's (1980) variety of *C. smithvillensis*. Campbell (1995: 146) stated that this form is the "most common *Conus* in the Santee Limestone" and that it "has a nodose shoulder and a taller, more tabulate spire than the widespread *Conus* (*Lithoconus*) *sauridensis*." Further study will be required to determine whether these varieties are indeed consistent with Harris's taxon.

Gardner (1945) described *C. highti* from the Laredo Formation of Zapata County, Texas. She did not figure her holotype (USNM 495182), but her figured (pl. 26, fig. 7) paratype specimen (USNM 495183) has a convex spire profile and rounded shoulder that appear distinct from those characters in *C. sauridensis*, *C. palmerae*, and *C. allenii*. Gardner's other figured (pl. 26, fig. 2) specimen of *C. highti* lacks this distinctive spire form.

NOMINA DUBIA

The following species of *Conus* described from the Eocene of the U. S. Coastal Plain should be regarded as *nomina dubia*: *Conus gyratus* Morton, 1834; *Conus multilatus* Tuomey, 1852; *Conus improvidus* de Gregorio, 1890; and *Conus cormacki* Harbison, 1944. *Conus gyratus* (holotype, ANSP 211) is an internal mold of a shell of uncertain provenance from South Carolina (also see Kohn, 1992); Campbell (1995) suggested that it could be an internal mold of the purported variety of *C. smithvillensis* presented by Dockery (1980). *Conus multilatus* was described (but not figured) by Tuomey from casts found near Wilmington, North Carolina. De Gregorio (1890) described *C. improvidus* from Claiborne, Alabama, but his holotype is reportedly lost (Palmer and Brann, 1966) and Palmer (1937: 465) considered the taxon "of doubtful status as an American species." *Conus cormacki* Harbison, 1944 was described from the Eocene Santee Formation of South Carolina, but the holotype (ANSP 16415, Figure 39, Table 2) is clearly not a *Conus*. Campbell (1995: 146) stated that *C. cormacki* "is actually a broken volutid."

Several other Eocene *Conus* species are also problematic. *Conus pulcherrimus* Heilprin, 1879 (type, AMNH-FI 10175) was recognized by Harris (1895) as a turrid (see Palmer and Brann, 1966). The type specimen of *Conus* (*Conospirus*) *granopsis* de Gregorio (1890) is lost (Palmer and Brann, 1966) and Dall (1896) and Palmer (1937) suggested that the small shell figured by de Gregorio (1890) may be the juvenile of another species. Given that the type specimen is lost and that the shell is likely a juvenile specimen, *C. granopsis* is a name that should probably be disregarded.

Finally, along with *Conus* sp. B (described here as the new species *C. palmerae*; holotype, UF 108555), Palmer in Richards and Palmer (1953) also noted a *Conus* sp. A. She said, "species A . . . is a broad (21 mm.), low-spined (7 mm.) shell with sharp angulation of the shoulder of the

whorls; the surface was apparently smooth. The specimen is a fragment, 25 mm. high" (Palmer, 1953: 40). We located this specimen (UF 108683), which—like UF 108555—is also a calcite pseudomorph from UF locality LV014, Gulf Hammock 02, Levy County, Florida (lower member of the Ocala Limestone). UF 108683 is poorly preserved and is too fragmentary (more than half of the spire is eroded away and much of the last whorl is missing) to either assign to a known species or to describe as new species.

ACKNOWLEDGMENTS

Sable Allen (Alexandria, Louisiana) graciously donated to the FLMNH the large, well-documented Eocene Gulf Coast mollusk collection of her late husband, James E. Allen. Larry Rogers (Limestone Products), Wayne Beaver (Denali Limerock Mine), Joe Horton (Suwannee American Cement), and Leon Brooks (Hi-Cal Quarry) kindly allowed access to collect in their Florida mines. Paul Callomon (Academy of Natural Sciences, Philadelphia) and Ann Molineux (Texas Memorial Museum) are thanked for allowing access to type specimens. Ann Molineux also provided helpful discussions on Eocene stratigraphy in Texas. Bushra Hussaini and Sandy Ebersole furnished information pertaining to an American Museum of Natural History specimen and a Geological Survey of Alabama specimen, respectively. Alan Kohn provided helpful discussions of and suggestions for terminology related to the "subsutural flexure" of cone shells. Sean Roberts (Florida Museum of Natural History) assisted us with some of the digital photography using a Sony DSC R1 camera (10.3 megapixel resolution). We thank Alan Kohn and an anonymous reviewer for comments that improved the quality of this manuscript. JRH's contributions to this work were supported by the Brayfield Award of the South West Florida Fossil Club and NSF EAR 0518976. RWP's contribution to this work was supported by the McGinty Endowment of the Florida Museum of Natural History, by Barbara and Reed Toomey, and by the late David Nicol whose \$1000 grant allowed RWP to permanently transfer the Florida Geological Survey Eocene mollusk collection from the Paleontological Research Institution (where it was under study by Katherine V.W. Palmer) to the Florida Museum of Natural History. This is University of Florida Contribution to Paleobiology 602.

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